Preoperative effects of progressive explosive-type resistance training in patients with osteoarthritis scheduled for total hip arthroplasty – a prospective randomized clinical trial

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staining identified CCR7 expression in the synovial lining layer, endothelium, and perivascular inflammatory infiltrates. Staining patterns were similar in meniscal and advanced OA patients, and in both patient groups was more pronounced than in asymptomatic organ donors.
Conclusion: This current study extends our previous findings by demonstrating a relationship between synovial CCL19 mRNA expression and knee-related difficulty with activities of daily living in typical patients presenting for arthroscopic meniscal surgeries. Although SF CCL19 protein was detectable in the majority of these patients, protein levels were not independently associated with knee symptoms. However, the receptor CCR7 was increased in patients compared with asymptomatic donors. Its expression by multiple cell types in synovium suggests that CCL19/CCR7 activity may be involved in development of synovitis in these patients.

Therapy - Non-Pharmacologic

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HIGHER BASELINE QUADRICEPS STRENGTH IS PROTECTIVE AGAINST INCIDENT RADIOGRAPHIC KNEE OA IN OVERWEIGHT AND OBESE WOMEN

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Purpose: Higher Quadriceps strength is thought to be protective against incident knee OA. Given the increased muscular requirements to control joint loads in overweight and obese individuals, this effect might even be greater in this population. The purpose of the present study is to evaluate the relationship between baseline Quadriceps strength and incident knee OA in subjects at high risk; middle-aged overweight and obese women, free of signs of knee OA.
Methods: We used data from the PROOF study. For this study, all women between 50 and 60 years registered at 50 general practitioners in the area of Rotterdam, the Netherlands, were contacted. All willing women with a BMI $\geq$ 27 kg/m2 and without knee complaints were invited for baseline measurements. All 407 included women filled in a questionnaire regarding knee complaints (including KOOS, VAS pain, number of days with knee pain) and physical activity (SQUASH questionnaire) and underwent physical examination and radiography of both knees. Isometric Quadriceps strength was measured in supine position, with the knee slightly flexed. A handheld dynometer was held at the distal part of the tibia and provided with resistance while the subject was asked to maximally extend their knee. Force in Newton was divided by body weight in kg. Based on the maximal score of three trials, subjects were divided in three equal groups; low, average and high strength. The primary outcome was incident knee OA, defined as incidence of K&L $\geq$ 2, the ACR-criteria, or joint space narrowing (JSN) $\geq$ 1.0 mm after 30 months. All knees with K&L $<$ 2 at baseline, with complete follow-up data were selected for the analyses. Using Generalising Estimating Equations, the association between Quadriceps strength and incident knee OA (primary outcome and all sub definitions separately) was determined for the average and high strength group, relative to the low strength group, adjusted for other baseline differences between groups and the randomized groups of the original trial.
Results: In total, 639 knees from 335 women were included in the analyses. Baseline characteristics are given in the Table 1. After 30 months, 17% of all knees showed incident knee OA. A trend towards a preventive effects in the highest strength group was found for the primary outcome (Table 2). This was probably driven by the incidence of radiographic knee OA, since the highest strength group had a significantly lower odds ratio for the incidence of K&L $\geq$ 2 compared to the lowest strength group.
Conclusions: Higher baseline isometric Quadriceps strength reduced the risk for incident radiographic knee OA after 30 months in overweight and obese women. Since the mean difference between the lowest and highest strength groups was only 1.5 N per kg body weight, strength training of knee extensors seems to be a simple and safe intervention to prevent radiographic knee OA in overweight and obese subjects.

Table 2
Incidence of knee OA and associated adjusted ORs for incident knee OA

Outcome	Low strength	Average strength	High strength
Knee OA	21% (reference)	19% 0.9 (0.5 - 1.7)	12% 0.6 (0.3 - 1.1)
Medial JSN	6% (reference)	5% 1.1 (0.4 - 2.7)	4% 0.9 (0.3 - 2.6)
Lateral JSN	5% (reference)	9% 1.8 (0.7 - 4.7)	5% 1.1 (0.4 - 3.1)
ACR criteria	7% (reference)	5% 1.0 (0.4 - 3.0)	4% 0.9 (0.3 - 2.6)
K&L $\geq$ 2	10% (reference)	4% 0.5 (0.2 - 1.4)	2% 0.3 (0.1 - 0.9)

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PREOPERATIVE EFFECTS OF PROGRESSIVE EXPLOSIVE_TYPE RESISTANCE TRAINING IN PATIENTS WITH OSTEOARTHRITIS SCHEDULED FOR TOTAL HIP ARTHROPLASTY – A PROSPECTIVE RANDOMIZED CLINICAL TRIAL

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Purpose: Hip Osteoarthritis (OA) is associated with pain, functional deterioration and loss of muscle function. Progressive explosive-type resistance training (RT) is effective in improving muscle strength and functional performance in healthy elderly. In hip OA patients the effects prior to THA remain unknown. The Purpose was to investigate the effect of progressive explosive-type RT in hip OA patients scheduled for THA on i) self-reported outcomes and ii) muscle function, physical function and body composition.
Methods: RCT. Eighty patients (age 70.4 $\pm$ 7.6 years, BMI 27.8$\pm$4.6, 70% females(n = 52)) diagnosed with hip OA and scheduled for primary THA were randomized into two groups: 1) The intervention group (IG) received supervised progressive explosive-type RT twice a week for 10 weeks; 4 exercises of 3 series each ($\sim$80% of 1 repetition max). 2) The control group (CG) received 'care as usual'. Outcomes: Primary; Hip Osteoarthritis Outcome Score (HOOS), secondary; leg extension power, functional tests, body composition (DXA). Adjusted between group changes from baseline to follow-up (2-5 days prior to surgery) were analyzed as intention-to-treat using multilevel regression.
Results: For HOOS ADL the IG scored 9.7 points 95%CI [4.3;15.2] higher compared to CG at follow-up (p = 0.001). For the remaining

Table 1
Baseline characteristics (* $p < 0.05$)

	All	Low strength	Average strength	High strength
N (knees)	639	199	209	231
Strength (N/kg)	2.92 $\pm$ 0.6	2.3 $\pm$ 0.4*	3.1 $\pm$ 0.2*	3.8 $\pm$ 0.4*
Age (yr)	55.7 $\pm$ 3.2	55.8 $\pm$ 3.0	55.9 $\pm$ 3.2	55.3 $\pm$ 3.3
BMI (kg/m2)	32.0 $\pm$ 3.9	34.2 $\pm$ 4.5*	32.0 $\pm$ 3.6*	30.0 $\pm$ 2.3*
Physical activity (SQUASH)	6860 $\pm$ 3634	6274 $\pm$ 3249*	6657 $\pm$ 3774*	7547 $\pm$ 3722*
History of knee injury	12%	13%	14%	9%
Postmenopausal status	68%	66%	72%	72%
Heberden nodes	26%	29%	27%	24%
K&L = 1	45%	54%*	38%*	43%*
Mild knee symptoms	28%	36%*	26%*	22%*
Varus alignment	39%	40%	36%	40%

4 HOOS subscales IG performed significantly better than CG ($p < 0.03$). IG had higher leg muscle power ($p < 0.0001$); better function (gait speed, stair-climb, sit-stand) ($p < 0.0001$) and increased lean body mass ($p = 0.013$) compared to CG. RT was well accepted in IG.

Conclusions: Hip OA patients scheduled for THA can comply with progressive explosive-type RT and significantly improve self-reported function and pain and muscle function, functional capacity and lean body mass. The present intervention prior to surgery holds promise for an optimized post-surgery rehabilitation.

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IDENTIFYING EXERCISES APPROPRIATE FOR PEOPLE WITH KNEE OSTEOARTHRITIS USING BIOMECHANICAL ANALYSES

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Purpose: Exercise is paramount to managing knee osteoarthritis (OA). In knee OA, leg strengthening exercises provide as much pain relief as medications. However, producing these benefits requires intense, repetitive exercise, which may further damage cartilage by increasing contact forces between the femur and tibia. Large loads on the medial knee, measured with the knee adduction moment (KAM), predict OA progression. The purpose of this study was to compare the magnitude of quadriceps activations and the KAM between static standing exercises. Our goal was to identify which standing exercises minimized the KAM while maximizing quadriceps activation to develop a program specifically for knee OA.

Methods: Thirty healthy, physically active women (24.4 ± 5.4 years, 61.5 ± 10.0 kg, 23.1 ± 3.7 kg/m2) participated. They performed 6 standing exercises while barefoot. Each was held static for 10 s, repeated 3 times, and presented in random order. The middle 5 s was selected for analysis. The standing postures targeted quadriceps strengthening: wide-legged squat, legs-together squat, lunge with trunk upright, lunge with trunk forward, hamstrings stretch, and single leg balance. The primary leg was the left leg during squats, the forward leg during lunges, and the standing leg during the hamstrings stretch and single leg stance.

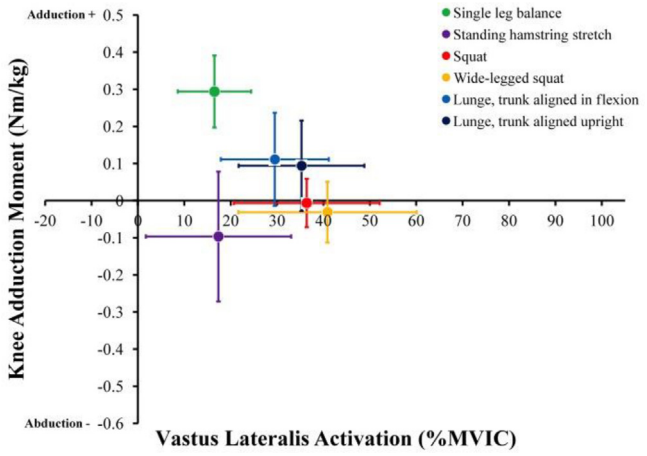
Electromyography (EMG) signals were collected on the left and right rectus femoris, vastus lateralis, vastus medialis, biceps femoris, and semitendinosus during the static exercises (Noraxon Telemyo DTS, Scottsdale AZ, USA). For each, muscle activation magnitude was normalized to a maximum voluntary isometric contraction (MVIC) performed on a dynamometer (Biodex System 2, Shirley NY, USA). Three motion capture camera banks (Optotrak Certus, Northern Digital Inc., Waterloo ON, Canada) tracked lower extremity position bilaterally. The motion capture system was synchronized with 3 in-ground force platforms (Advanced Medical Technology Inc., Watertown, MA, USA). Inverse dynamics was used to calculate external knee moments for both left and right legs using a floating axis joint coordinate system (C-Motion Inc., Germantown MD, USA). The mean KAM from each of the 3 trials was averaged and normalized to body mass. A two-factor repeated measures analysis of variance (ANOVA) consisting of exercise and leg (primary, secondary) was used to identify differences between EMG amplitudes and mean KAM (α=0.05).

Results: Quadriceps activations were 10.9-38.9 %MVIC during the exercises. Activations of the quadriceps muscles were higher during squats and lunges than during the standing hamstrings stretch and single leg balance exercise ($p \leq 0.001$). The primary leg showed higher vastus medialis and vastus lateralis activations than the secondary leg during both lunge exercises ($p < 0.05$).

All but one exercise yielded a mean KAM ≤0.18 Nm/kg in the primary and secondary legs (Figure 1). A mean knee abduction moment was achieved during squats and the hamstrings stretch in both the primary and secondary leg; as well as the secondary leg during the lunges. The single leg balance exercise yielded a mean KAM of 0.29 ± 0.13 Nm/kg in the primary leg. The wide-legged squat and the lunge with the trunk upright produced lower KAMs compared to a lunge with the trunk forward and a standing hamstrings stretch ($p \leq 0.006$). The mean KAM was higher for the primary leg than the secondary leg for both lunge exercises; and were higher for the secondary leg than the primary leg for the standing hamstrings stretch ($p < 0.05$).

Conclusions: Several exercises yielded low mean KAM values suggesting these are appropriate for exercise prescription for people with knee OA. During level walking at a self-selected speed, the peak KAM is ~0.40 ± 0.13 Nm/kg. Thus, the peak medial knee load during these exercises was ~33% of the peak KAM during gait. The principles underlying these "low KAM" exercises are consistent with strategies to reduce KAM in the literature: body centre of mass placed over the knee; exercise completed barefoot; external rotation of the foot when appropriate; low/no speed; and low repetition. The findings suggest that single-leg exercises should be avoided to minimize exposure to KAM.

The magnitude of quadriceps activation for these exercises was below 40% MVIC, which is the threshold recommended for strengthening. Though most of the exercises did not produce mean KAM values of concern, the magnitude of quadriceps activation may be too low to produce strengthening. It is possible that these exercises would yield higher activation magnitudes in older adults with knee OA. Future studies should explore the KAM and quadriceps activations in people with knee OA.



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DO LATERALLY WEDGED INSOLES AND VALGUS KNEE BRACES REALLY UNLOAD THE MEDIAL COMPARTMENT OF THE KNEE? RESULTS OF A RCT

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Background: In patients with osteoarthritis (OA) of the medial compartment of the knee, symptom reduction and functional improvement were reported with the valgus unloader knee brace or the laterally wedged insole. These clinical effects are attributed to the mechanical unloading of the diseased compartment. However, the exact working mechanism is not fully understood and remains a subject of discussion. Because no static correction of malalignment was seen in prior studies, another possible explanation for the clinical improvement could be a dynamic alteration, in other words a changed gait pattern. For this reason we performed gait analysis of patients wearing a laterally wedged insole or valgus knee brace.

Purpose: The aim of the present study was to evaluate the dynamical biomechanical alterations of patients with medial knee OA treated with a laterally wedged insole or valgus knee brace.

Methods: In this prospective trial, we randomized 91 patients with early medial knee OA to a laterally wedged insole or valgus knee brace. At baseline and after 6 months, walking distance, use of pain medication, VAS-pain score, WOMAC-score, complications and compliance were determined. Gait was analyzed with and without wearing of the orthosis at baseline and after 6 weeks. Kinematic data were collected using three infrared cameras and a force plate. Measurements were taken of the knee adduction moment (KAM), ground reaction force (GRF), moment arm (MA), walking speed and toe-out angle.

Results: A mean reduction of 3.6% (± 9.6) of the peak KAM and 3.7% (± 12.9) of the MA at baseline (immediately after placement of the device) were observed in the insole group. After 6 weeks a mean reduction of